

No satisfactory medicinal treatment for the destruction of thread lungworms is known. Inhalants and intratracheal injections of various drugs have been tried, but frequently they are more injurious than beneficial to the host and they are hard to give.

The hair lungworm can be killed by an intramuscular injection of emetine hydrochloride, but such a treatment should be administered by a veterinarian. Emetine hydrochloride is a potent drug, and an overdose may result in serious damage or death. Care must be used to keep it from contact with the eyes, as it is highly irritant. It should not be used near shearing time because it may cause sheep to shed.

Preventing infection is the best means of combating lungworms. The general measures recommended for keeping livestock healthy apply.

The following measures are especially important in minimizing lungworm infection. The use of wet areas for pastures should be avoided as they are favorable habitats for the develop-

ment of the thread lungworm larva and the intermediate hosts of the hair lungworm and the red lungworm.

It is desirable to rotate animals to clean pastures whenever practicable.

The use of dry feed, in racks designed to prevent contamination with droppings, and uncontaminated water will minimize the acquisition of parasites.

Sick animals and heavily infected ones should be kept from contaminating pastures with their droppings. They should be removed to dry lots to prevent additional infection with lungworms.

An adequate diet, and removal of gastrointestinal parasites by anthelmintics, remedies for worm infections, are deemed to be of considerable value in building up the vigor of the animal and consequently counteracting the effects of lungworm infection.

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## Scabies in Sheep and Goats

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FIVE KINDS of parasitic mites cause scabies, or scab, in sheep and goats.

Common scabies, or psoroptic scabies, is highly contagious to all classes of sheep. It is transmitted readily and quickly from one animal to another by direct contact.

It is caused by tiny, ovoid, pearl-white mites, *Psoroptes equi* var. *ovis*. The female mite is about one-fortieth of an inch long. A hand lens should be used when one examines infested animals for the mites. The adults have four pairs of brownish legs and sharp, pointed, brownish mouth parts.

The mites live on blood serum that oozes from skin punctures, which the mites make with their sharp mouth parts. Into the tiny wounds they probably secrete a poisonous substance. Bluish-red, inflamed, swollen areas surround the punctures. The serum on the skin becomes mixed with debris, which soon dries, hardens, and forms a crust, or scab. As the lesion develops, the skin becomes thickened, hard, and wrinkled. It might crack and bleed when it is manipulated with the fingers. The uniformly thickened condition of the diseased skin is readily

detected by comparing it with the pliable, healthy skin.

Chronically diseased areas become hardened and covered with a tightly adhering, scaly, grayish crust. The grayish color results from the accumulation of dried flakes of skin. The wool falls out and leaves bare areas, which enlarge as the disease advances and make the sheep look naked. The mites seek the healthier skin at the outer edges of a lesion, produce more punctures, and thereby cause the lesions to spread. The mites can be found most easily at the outer edges of the lesions.

The mites cause intense irritation and itching. Infested sheep become restless and furiously scratch, rub, kick, and nibble at their wool. The fleece soon has a broken, disturbed appearance. From the fleece hang tags or tufts of wool, which the sheep have pulled out with their mouths or scratched out with their hind feet. Their discomfort is especially noticeable after they have been active. The wool on affected areas within reach of the animals' mouths may be dirty and wet with saliva. Licking the lips and champing the jaws while scratching are characteristic movements of sheep affected with scabies.

The first lesions usually are on the back or sides, but may start on any part of the body.

The only way to be sure that a sheep has scabies is to find the mites. Any condition that causes the sheep to bite and scratch themselves should be investigated at once.

As the wool is parted over a lesion, the mites move away from the light and may be picked up on the edge of a knife blade. The best way to find mites is to scrape the outer edge of the lesion with a blunt blade of a pocketknife, transfer the scrapings to a sheet of black paper, and examine the material under bright light. If the material is slightly warmed by sunlight or a lamp, the mites become active. They are plainly visible with a hand lens.

Clean sheep do not commonly contract scabies from infested premises,

but they may become infested from premises or bed grounds very recently occupied by infested sheep. Premises that have been vacant for about a month are safe for use by clean sheep.

Freshly dipped sheep do not become infested from contaminated premises and therefore may be safely held there between the first and second dippings. It is a good sanitary practice, however, to avoid old bed grounds and unclean corrals.

The disease may be contagious at all seasons, but new infestations are uncommon in summer. Scabies often remains dormant during hot, dry weather and may seem to be cured, but usually it becomes evident again with the arrival of cold, rainy weather.

An attack does not give immunity. A flock may become infested any number of times.

Goats and cattle herded with sheep may be temporary carriers and may even develop lesions of short duration. Therefore they should be included when the flock is treated.

We used to think that psoroptic mites of sheep were not transferable to cattle or to any other class of livestock.

Tests at the Animal Disease and Parasite Research Laboratory at Albuquerque, N. Mex., showed, however, that common sheep scabies could be transmitted from sheep to cattle and then back to clean sheep. Lesions containing psoroptic mites were found on December 27, 1950, on a cow that had been kept with 10 scabies-infested sheep for 15 months. Six months later the disease appeared on a bull that also had been with the sheep. The original infestation on the cow and bull was maintained continuously on them for more than 4 years. Skin scrapings containing live psoroptic mites were removed from the cow every day for 2 weeks and placed in the wool of scabies-free sheep. Live mites became established in the wool 4 days after the first transplant. Small lesions and some loss of wool were observed during the first month. The sheep developed extensive and typical scabies within 3 months.

FOOT SCABIES, also called chorioptic or symbiotic scabies, is caused by mites known as *Chorioptes bovis* (of the variety *ovis*, if they are on sheep, or the variety *caprae*, if they infest goats).

The mites resemble the common scab mites and live in groups on the surface of the skin, usually on the lower parts of the legs and around the feet. They spread to the inner surfaces of the thighs and to the udder and abdomen in severe cases.

Chorioptic scabies is much more common in goats than in sheep. The visible lesions usually occur initially around the feet and are most pronounced during cold weather when the flock is housed.

SARCOPTIC SCABIES, often known as head scab or black muzzle, has been found on sheep in Europe but not in the United States. It is caused by the mite *Sarcoptes scabiei* var. *ovis*.

The mite burrows into the skin on the head and face, where there is little or no wool. Like common scabies, it causes intense itching and irritation. The infested animals rub and scratch the affected parts and hard, firmly attached scabs are formed.

Sarcoptic scabies may be told from common scab by the nature and location of the lesions and its tendency to remain localized on parts that are not covered with wool.

DEMODECTIC SCABIES usually is referred to as demodectic or follicular mange.

It is quite common in goats. It is found only rarely in sheep—usually in the small glands of the eyelids. The infestations in sheep do not cause much trouble.

In goats the mites infest the sebaceous, or oil, glands of the skin, which become filled with a thick, cheesy substance that contains thousands of mites. The swollen glands look like nodules in the skin. They may be as small as a wheat seed or as large as a walnut. The nodules are found oftenest at the base of the neck in front of the

shoulders. They also occur over the back, hips, flanks, ears, and jaws. To find them, one must run his hands over the animal's body.

The contents of some nodules can be squeezed out between the fingers, but sometimes they must be incised. In order to see the mites, the material from the nodules must be examined under a microscope. They look quite different from other mites that infest livestock. The elongated body is divided into the anterior part, which bears the head; thorax, with legs attached; and the abdomen. About 100 or 125 of them measure an inch. The legs are short and stout. The mites have sucking mouth parts.

PSORERGATIC SCABIES was first found in the United States on sheep in Ohio in 1951. It had been reported on Merino sheep in Australia in 1941.

The mite causes a mild irritation and itchiness like that caused by lice. The sheep bite and scratch the parts most easily reached, such as the sides, flank, and rump. Tags of wool are pulled out, and the fleece has a ragged, tangled appearance. The tips of the wool fibers are twisted or curled into locks or matted and hang loosely from the sides.

The psorergatic mites are about one-third as big as the common scab mite. The head is short and broad. The general form of the body is rounded. Eight short legs extend from the sides of the body at equal distances from one another. Each leg has a double hook. The mite burrows into the skin, causing a slight thickening, roughening, and scaling of the affected area. The scabs are usually loose, dry, and crumbly. Moist spots sometimes exist in the lesion.

The small size and burrowing of the mites make them hard to find. One has to make deep skin scrapings with a scalpel or pocketknife and examine the material in light mineral oil under a microscope. The infestation spreads slowly and may take 3 or 4 years to become generalized on a sheep. The intensity of infestations may vary year

to year. Some animals appear to recover, but usually there is a recurrence.

TREATMENT of sheep and goats infested with psoroptic and chorioptic scabies is with dips approved by the Department of Agriculture. The approved dips contain lime-sulfur, nicotine sulfate, wettable BHC, or wettable lindane.

Lime-sulfur dips are made in the proportion of 8 pounds of unslaked lime and 24 pounds of flowers of sulfur, or sulfur flour, to 100 gallons of water. If commercial hydrated lime, not air slaked, is used, 11 pounds per 100 gallons of water is required. If nicotine sulfate is used, the dip should contain not less than 0.05 percent nicotine. These two dips must be heated and maintained at 95° to 105° F. The sheep and goats must be dipped at least twice at intervals of 10 to 14 days.

Dips prepared from BHC (benzene hexachloride) or lindane should be prepared from wettable powders and the content of gamma isomer, the active insecticidal ingredient, should be maintained at 0.06 percent. BHC and lindane were approved by the Department of Agriculture in 1954 for the treatment of sheep infested with scabies or exposed to it. They have several advantages over lime-sulfur and nicotine sulfate.

Dips prepared from BHC and lindane must not be heated above 80° F. One treatment with BHC or lindane, properly applied, is enough to cure the common form of sheep scabies and foot scabies of goats.

The dipping vat should be filled with enough clean, unheated water to cover the animals—ordinarily 40 to 48 inches deep. After the water is measured and put into the vat, the required amount of BHC powder is added and thoroughly stirred. The dip should be stirred again after any interruption in dipping.

Each animal must be held in the dip not less than 1 minute to assure saturation of the skin and fleece. The head of each animal should be submerged

at least twice for an instant so that the wool and hair about the head and face are thoroughly wet.

Small lambs should be dipped in a barrel. After they are a month old, it is safe to let them swim through the vat, but they should not be put into the vat with adult sheep.

The dip should be changed as soon as it becomes filthy, regardless of the number of sheep that have been dipped in it.

Because BHC, lindane, lime-sulfur, and nicotine sulfate do not kill or check bacteria, open cuts or wounds may become infected with dirty dip. Sheep that are weak and in poor physical condition should not be dipped because of the danger (especially when BHC or lindane are used) of killing them.

NO SPECIFIC RECOMMENDATIONS are made for treating sarcoptic, demodectic, or psorergatic scabies.

Many treatments have been suggested for controlling the demodectic mange of goats, but none of them has been completely effective. The lesions in goats are prominent enough to be treated locally. Some of the investigators report good results by opening the nodules, removing the contents, and irrigating the pockets with a 2-percent solution of coal tar-cresote dip. Good results also have been had from a few drops of a saturated solution of carbolic acid used in a similar manner.

In the absence of a satisfactory treatment, the infested animals should be isolated from the rest of the flock.

Attempts to control psorergatic scabies with BHC have shown some promise, but precise recommendations depend on further experiments.

One dipping in suspensions containing 0.06 percent of gamma isomer of wettable BHC or lindane makes it possible to eradicate psoroptic and chorioptic scabies from sheep and goats.

The use of this simple and reliable dip and the effective cooperation of livestock owners and State and Fed-

eral officials can eradicate this scourge of the sheep and goat livestock industry.

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From 1943 to his retirement in 1955, he directed research on external parasites of livestock at the Department's field station at Albuquerque, N. Mex.

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## Head Grubs of Sheep

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HEAD grubs inhabit the nasal passages and adjoining cavities in sheep. They cause heavy losses everywhere.

The grubs are the larval, or maggot, stage of the sheep botfly, *Oestrus ovis*, which also is called the sheep gadfly or nasal fly. The fly is slightly larger than the common housefly. It is brownish gray and hairy. It can dart quickly in and out among sheep and occasionally hovers in front of a sheep's nose. Sometimes it remains motionless for some time on the ground.

The fly has no functional mouth parts; so it does not bite or feed. It has no stinger. Its sole purpose in life apparently is to reproduce its kind and deposit its young in sheep's nostrils.

The female fly deposits tiny larvae—not eggs—through a small, flexible tube, which she extends from the rear of her abdomen. She makes repeated, persistent attacks on different sheep, depositing a few larvae at a time. A fly can deposit 500 young grubs during her lifetime. When conditions are favorable she completes her deposition of larvae within a few days and then dies. During periods of cold or stormy weather, when conditions are not favorable for flight, she conserves her energy for later attacks on sheep by

remaining motionless in some sheltered spot and so may live for 2 weeks.

The sheep botfly is hard to see—it flies fast, and at rest its coloring usually blends with the surroundings. But sheep recognize its presence at once and become nervous and agitated. They stop feeding and gather in groups with their noses held close to the ground. They become alert, stare at the ground, stomp their feet, and snort or sneeze.

Just how the fly accomplishes the deposition of its young in the sheep's nostrils we do not know. It is thought that since practically all sheep become infested with head grubs, the fly must somehow come in contact with the nostrils. Perhaps she does so by quick, darting attacks while hovering in front of the sheep's nose or from the position she assumes on the ground near the places where sheep are feeding or resting.

After the sheep botfly makes a deposit of her young in or on the moist edges of the nostrils, the tiny grubs crawl quickly back into the nasal passages. There they move about over the mucous membranes, feeding on the mucus secreted by the tissues. Many conceal themselves within the